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## ANNEX 4

COMMISSION STAFF WORKING DOCUMENT

### *IMPACT ASSESSMENT*

*Accompanying document to the*

COMMUNICATION FROM THE COMMISSION TO THE COUNCIL, THE EUROPEAN  
PARLIAMENT, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE  
COMMITTEE OF THE REGIONS

TOWARDS A SPACE STRATEGY FOR THE EUROPEAN UNION THAT BENEFITS ITS  
CITIZENS

SEC(2011) 381 final  
COM(2011) 152 final



exclusive patent rights and now integrates these materials into textiles or onto finished apparel, providing temperature regulation in bedding materials and a full line of apparel for both ordinary and extreme conditions.

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### **Tiny Devices Project Sharp, Colorful Images**

Displaytech Inc., based in Longmont, Colorado, and recently acquired by Micron Technology Inc., of Boise, Idaho, first received an SBIR contract in 1993 from Johnson Space Center to develop tiny, electronic, color displays, called microdisplays. Displaytech has since sold over 20 million microdisplays and was ranked one of the fastest growing technology companies by Deloitte and Touche in 2005. Customers currently incorporate the microdisplays in tiny pico projectors, which weigh only a few ounces and attach to media players, cell phones, and other devices. The projectors can convert a digital image from the typical postage stamp size into a bright, clear, 4-foot-wide projection. The company believes sales of this type of pico projector may exceed \$1.1 billion within 5 years.

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### **Environmental and Agricultural Resources**



### **Star-Mapping Tools Enable Tracking of Endangered Animals**

Software programmer Jason Holmberg, of Portland, Oregon, partnered with a Goddard Space Flight Center astrophysicist to develop a method for tracking the elusive whale shark using the unique spot patterns on the fish's skin. Employing a star-mapping algorithm

originally designed for the Hubble Space Telescope, Holmberg created a photograph database and pattern-matching system that can identify whale sharks by their spots and match images contributed to the database by photographers from around the world. The system has been adapted for tracking other rare and endangered animals, including polar bears and ocean sunfish.

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### **Nanofiber Filters Eliminate Contaminants**

With support from SBIR funding from Johnson Space Center, Argonide Corporation, of Sanford, Florida, tested and developed its proprietary nanofiber water filter media. Capable of removing more than 99.99 percent of dangerous particles like bacteria, viruses, and parasites, the media was incorporated into the company's commercial NanoCeram water filter, a 2002 "R&D 100" award winner and 2005 inductee into the Space Foundation's Space Technology Hall of Fame. In addition to its drinking water filters, Argonide now produces large-scale nanofiber filters used for industrial and municipal water purification.

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### **Modeling Innovations Advance Wind Energy Industry**

In 1981, Glenn Research Center scientist Dr. Larry Viterna developed a model that predicted certain elements of wind turbine performance with far greater accuracy than previous methods. The model was met with derision from others in the wind energy industry, but years later, Viterna discovered it had become the most widely used method of its kind, enabling significant wind

energy technologies—like the fixed pitch turbines produced by manufacturers like Aerostar Inc., of Westport, Massachusetts—that are providing sustainable, climate friendly energy sources today.

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### **Thermal Insulation Strips Conserve Energy**

Flexible aerogel technology developed by Aspen Aerogels, of Northborough, Massachusetts, under SBIR contracts with Kennedy Space Center, is now being employed in a building insulation application by Tampa, Florida-based Acoustiblok Inc. The company's Thermablok flexible aerogel strips—easy-to-install and environmentally friendly—are applied to wall studs in buildings to break the thermal bridging between the interior and exterior walls, boosting the insulation factor by as much as 42 percent.

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### **Satellite-Respondent Buoys Identify Ocean Debris**

As part of its ocean-observing work, NASA partnered with NOAA and private industry to develop remote sensing technologies for protecting the seas of the North Pacific from derelict fishing gear. As part of this program, Airborne Technologies Inc. (ATI), of Wasilla, Alaska, developed a system using satellite-responsive buoys to monitor the convergence of currents in order to track high seas debris. ATI has now built over 900 of the buoys, and that original work has also led to the development of a prototype unmanned aircraft system and unique complementary software designed to process ocean images to detect debris fields.

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### Mobile Instruments Measure Atmospheric Pollutants

Under SBIR contracts from Glenn Research Center, Billerica, Massachusetts-based Aerodyne Research Inc. (ARI) has created spectrometers for use in mobile laboratories to study ground-based air pollution. ARI developed its tunable infrared laser differential absorption spectrometers to detect a range of more than 15 of the most important greenhouse gasses and air pollutants, including carbon dioxide, nitrogen dioxide, and methane. In addition to mobile measurements from van, aircraft, and ship platforms, ARI and its customers use the instruments to determine the magnitude of pollutant emissions. The company's products are currently in use in numerous climate change laboratories on five continents.

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### Cloud Imagers Offer New Details on Earth's Health

Boulder, Colorado-based Stratton Park Engineering Company Inc. (SPEC) has won numerous SBIR contracts to develop atmospheric instrumentation, including a Phase II SBIR from NASA's Jet Propulsion Laboratory for cloud particle imagers. The SPEC Cloud Particle Imager (CPI) has been installed on NASA's high-altitude research aircraft and has been sold to universities and agencies around the world. Mounted to airplane exteriors, the CPI system captures images of cloud particles, enabling further analysis for climate predictions and research.

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### Antennas Lower Cost of Satellite Access

SeaSpace Corporation, of Poway, California, worked with NASA's Jet Propulsion Laboratory under two SBIR contracts to reduce the cost of satellite ground tracking. The resulting hardware and software not only complement NASA's remote sensing capabilities but also benefit the greater research community, tracking low-Earth orbit satellites for remote sensing; science; communications; and telemetry, tracking, and command applications, providing true full hemispherical coverage. The company's ground-based receivers are now in continuous operation on all seven continents, with customers including aerospace and defense clients, the scientific community, national and local weather services, the research industry, and public safety organizations.

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### Feature Detection Systems Enhance Satellite Imagery

Supported by SBIR contracts with Stennis Space Center, Geospatial Data Analysis Corporation of State College, Pennsylvania, invented software for automatically identifying clouds in satellite imagery without the use of thermal data—an important development for satellites that forgo expensive thermal imaging equipment. The company's software provides highly accurate cloud identification for private remote sensing imagery firms, and the technology's feature detection capabilities are also being applied to a range of land features, helping researchers study the effects of population growth and climate change on crop field acreage, flood zones, and plant cover.

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### Chlorophyll Meters Aid Plant Nutrient Management

Spectrum Technologies, headquartered in Plainfield, Illinois, licensed a hand-held plant chlorophyll meter developed from Stennis Space Center's research on satellite sensors. The meter measures light to determine a plant's chlorophyll content—a strong indicator of plant health. Spectrum improved the NASA technology and commercialized it as its FieldScout meters. Growers and agricultural researchers can now use the meters to determine the nutrient needs of crops like wheat, rice, cotton, and corn. The meters are also effective nutrient management tools for turf grass, making them ideal for the maintenance of golf courses and athletic fields.

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### Computer Technology



### Telemetry Boards Interpret Rocket, Airplane Engine Data

Through a Space Act Agreement with Kennedy Space Center, telemetry innovator Ulyssix Technologies Inc., of Frederick, Maryland, is furthering its long-standing NASA relationship and expanding its commercial telemetry expertise. Ulyssix's telemetry hardware—like its TarsusPCM processing board used by Kennedy to gather and translate data on rocket and space shuttle launches—is being employed for jet engine and airplane testing and development, as well as ground support equipment for satellites. The hardware may also become a part of private space industry projects, all while still supporting NASA efforts, such as testing for the Constellation Program.

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### Programs Automate Complex Operations Monitoring

Command and Control Technologies Corporation (CCT), of Titusville, Florida, licensed software created to automate mission-critical applications at the Kennedy Space Center launch complex. The company now applies the same management technologies created for NASA launches to other complex yet critical operations: weapons test ranges, borders protection, and large industrial processes, like monitoring and managing power plants.

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### Software Tools Streamline Project Management

Three innovative software inventions from Ames Research Center (NETMARK, Program Management Tool, and Query-Based Document Management) are finding their way into NASA missions as well as industry applications. The three software tools have been bundled together for the purpose of executing a nonexclusive patent license, and JumpStart Solutions LLC, of Cave Creek, Arizona, licensed them for use in its PanOptica product suite. The company now offers customers a cost-effective, scalable, easy-to-use suite of tools to manage projects, portfolios, and knowledge bases and documents.

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### Modeling Languages Refine Vehicle Design

Cincinnati, Ohio's TechnoSoft Inc. is a leading provider of object-oriented modeling and simulation technology used for commercial and defense applications. With funding from SBIR contracts issued by Langley Research Center, the company continued development

on its adaptive modeling language, or AML, originally created for the U.S. Air Force. TechnoSoft then created what is now known as its Integrated Design and Engineering Analysis Environment, or IDEA, which can be used to design a variety of vehicles and machinery. IDEA's customers include clients in green industries, such as designers for power plant exhaust filtration systems and wind turbines.

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### Radio Relays Improve Wireless Products

Signal Hill, California-based XCOM Wireless Inc. developed radio frequency microelectromechanical systems (RF MEMS) relays with a Phase II SBIR contract through NASA's Jet Propulsion Laboratory. In order to improve satellite communication systems, XCOM produced wireless RF MEMS relays and tunable capacitors that use metal-to-metal contact and have the potential to outperform most semiconductor technologies while using less power. These relays are used in high-frequency test equipment and instrumentation, where increased speed can mean significant cost savings. Applications now also include mainstream wireless applications and greatly improved tactical radios.

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### Industrial Productivity



### Advanced Sensors Boost Optical Communication, Imaging

Brooklyn, New York-based Amplification Technologies Inc. (ATI) employed SBIR funding from NASA's Jet Propulsion Laboratory to forward the company's solid-state photomultiplier technology. Under the SBIRs, ATI developed a small, energy-

efficient, extremely high-gain sensor capable of detecting light down to single photons in the near infrared wavelength range. The company has commercialized this technology in the form of its NIRDAPD photomultiplier, ideal for use in free space optical communications, lidar and ladar, night vision goggles, and other light sensing applications.

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### Tensile Fabrics Enhance Architecture Around the World

Using a remarkable fabric originally developed to protect Apollo astronauts, Birdair Inc., of Amherst, New York, has crafted highly durable, safe, environmentally friendly, and architecturally stunning tensile membrane roofs for over 900 landmark structures around the world. Travelers in airports, sports fans at stadiums, and shoppers in malls have all experienced the benefits of the Teflon-coated fiberglass fabric that has enabled Birdair to grow from a small company established in its founder's kitchen in 1956 to a multi-million-dollar specialty contractor today.

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### Robust Light Filters Support Powerful Imaging Devices

Infrared (IR) light filters developed by Lake Shore Cryotronics Inc., of Westerville, Ohio—using SBIR funding from NASA's Jet Propulsion Laboratory and Langley Research Center—employ porous silicon and metal mesh technology to provide optical filtration even at the ultra-low temperatures required by many IR sensors. With applications in the astronomy community, Lake Shore's SBIR-developed filters are also promising tools for use in terahertz imaging, the next wave of technology for applications



like medical imaging, the study of fragile artworks, and airport security.  
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### **Thermoelectric Devices Cool, Power Electronics**

Nextreme Thermal Solutions Inc., based in Research Triangle Park, North Carolina, licensed thermoelectric technology from NASA's Jet Propulsion Laboratory. This has allowed the company to develop cutting edge, thin film thermoelectric coolers that effectively remove heat generated by increasingly powerful and tightly packed microchip components. These solid-state coolers are ideal solutions for applications like microprocessors, laser diodes, LEDs, and even potentially for cooling the human body. Nextreme's NASA-enabled technology has also resulted in embedded thermoelectric generators capable of powering technologies like medical implants and wireless sensor networks.  
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### **Innovative Tools Advance Revolutionary Weld Technique**

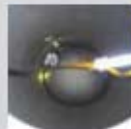
Nova-Tech Engineering LLC, of Lynnwood, Washington, received a co-exclusive license for Marshall Space Flight Center technology that significantly improves an advanced welding technique called friction stir welding (FSW). The technique creates a superior weld to traditional fusion methods, but leaves a hole when the welding machine's rotating pin, which creates the weld, exits the weld joint. It also has difficulty welding materials of tapering thicknesses. Marshall invented an auto retractable pin tool that solves these problems. The innovation now allows Nova-Tech's FSW machines to perform effective welds for offshore drilling rig piping,

armor plating, and rocket manufacturing.  
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### **Methods Reduce Cost, Enhance Quality of Nanotubes**

SBIR contracts with Johnson Space Center supported the development and demonstration of a nanotube production method pioneered by SouthWest NanoTechnologies Inc. (SWeNT), of Norman, Oklahoma. SWeNT's scalable, efficient process results in mass-produced nanotubes that are customizable to client needs and more pure than those created by other methods. These enhanced manufacturing capabilities may soon allow for nanotube-enabled technologies like advanced body armor, ultra-conductive wiring, printable electronics, and green innovations like more affordable solar panels and low-energy, solid-state lighting products. SWeNT's NASA-supported process has allowed the company to increase production a hundredfold while lowering cost tenfold.  
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### **Gauging Systems Monitor Cryogenic Liquids**

With SBIR awards from Kennedy Space Center, Sierra Lobo Inc. (SLI), based in Fremont, Ohio, developed the Cryo-Tracker Mass Gauging System (Cryo-Tracker MGS). The Cryo-Tracker MGS is a three-part system that integrates the use of software, electronics, and the "R&D 100" award-winning Cryo-Tracker probe. SLI is marketing the Cryo-Tracker MGS to companies that use and store cryogenics, including medical organizations, metals processors, and semiconductor manufacturers, which use the Cryo-Tracker MGS to monitor mass, liquid levels, temperature, and pressure for

stored liquid helium, hydrogen, nitrogen, or oxygen. SLI began with only nine employees in 1993, and now has an ISO 9001:2008 registration and over 370 employees.  
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### **Voltage Sensors Monitor Harmful Static**

A tiny sensor, small enough to be worn on clothing, now monitors voltage changes near sensitive instruments after being created to alert Space Agency workers to dangerous static buildup near fuel operations and avionics. San Diego's QUASAR Federal Systems Inc. received an SBIR contract from Kennedy Space Center to develop its remote voltage sensor (RVS), a dime-sized electrometer designed to measure triboelectric changes in the environment. One of the unique qualities of the RVS is that it can detect static at greater distances than previous devices, measuring voltage changes from a few centimeters to a few meters away, due to its much-improved sensitivity.  
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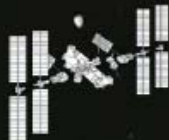
### **Compact Instruments Measure Heat Potential**

Based in Huntsville, Alabama, AZ Technology Inc. is a woman- and veteran-owned business that offers expertise in electromechanical-optical design and advanced coatings. AZ Technology has received eight SBIR contracts with Marshall Space Flight Center for the development of spectral reflectometers and the measurement of surface thermal properties. The company uses a variety of measurement services and instruments, including the Spectrafire, a compact spectral emissometer it used to assist General Electric Company with the design of its award-winning Giraffe Warmer for neonatal intensive care units.  
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# NASA Technologies Enhance Our Lives on Earth

## International Space Station



## Space Telescopes and Deep Space Exploration



## Satellites and Imaging Technology



Innovative technologies from NASA's space and aeronautics missions (above) transfer as benefits to many sectors of society (below). Each benefit featured in *Spinoff 2009* is listed with an icon that corresponds to the mission from which the technology originated. These NASA-derived technologies, when transferred to the public sector:

### Health and Medicine



Extend Medicine's Reach  
page 32



Assess, Treat Balance Disorders  
page 34



Advance Disease Treatments  
page 36



Provide Nutritional Guidelines  
page 38



Speed Rehabilitation  
page 40



Revitalize Patient Care  
page 42



Optimize Busy Hospital Schedules  
page 44



Assess Cognitive Fitness  
page 46



Treat Dehydration  
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### Transportation



Lighten Designs, Maintain Structural Integrity  
page 52



Save Money, Increase Safety  
page 54



Resist Extreme Temperatures  
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Locate Radio Interference  
page 58



Improve Airport Efficiency  
page 60



Advance Aerospace Manufacturing  
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### Public Safety



Provide Early Warning of Biological Threats  
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Save Soldiers' Lives Overseas  
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Save Hundreds of Sailors  
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Enhance Scientific Instruments and Safety Devices  
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Protect Payloads and Public Safety Officers  
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### Consumer, Home, and Recreation



Point to Fishing Hotspots  
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Eliminate Pathogens, Preserve Food  
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Protect Sensitive Skin from UV Rays  
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Control Temperature  
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Project Sharp, Colorful Images  
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